Studies of British Tree- and Earth-worms.

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[Read 5th May, 1892.]

(Plate XXI.)

I. On the Tree-worms of Great Britain.

Hitherto no attention whatever seems to have been paid by English naturalists to that group of worms whose principal habitat is the old and decaying stumps or trunks of fallen trees, and whose chief service consists in the breaking up of useless timber, and reducing it to vegetable mould. When I commenced the study of these animals two years ago nothing was known of the subject in this country, and I was therefore compelled to examine the works of such continental naturalists as Eisen, Rosa, and Levinsen, in order to ascertain the character of those tree-worms which had already been made known to the scientific world. Thanks to their industry it has been possible for me to identify every species hitherto discovered in Great Britain. So far as present research enables us to speak definitely on the subject, we have no tree-worms peculiar to this island. Every species hitherto examined is known to occur in one or other of the countries of Europe, from Russia and Scandinavia to Brittany and the Italian peninsula.

But though it has not fallen to the lot of our countrymen to add any species of arboreal worm to the list of new discoveries, it must be admitted that foreign writers on the subject have, so far, almost without exception, failed to recognize the affinities of the group, and present us with any satisfactory system of classification. I purpose therefore, in the present paper, giving the whole subject a careful revision in the light of our indigenous species, with this proviso, however, that when our boreal species have been as carefully worked as I have worked those species which are found south of the Clyde, it may be necessary to somewhat modify the characters of the group.

Eisen was the first naturalist to show that the worms which were formerly included in the genus *Lumbricus* were marked by such differences as would justify the creation of new genera. He accordingly, in 1873, took the family Lumbricidæ and split it up into four genera—*Lumbricus*, *Allolobophora*, *Dendrobæna*, and

Allurus. He has since added *Tetragonurus*. The curious point to be noticed is, that though Eisen created the genus *Dendrobæna*, he did not recognize the species which would naturally fall under that generic designation, and hence his perfectly natural and appropriate term has been quietly ignored. It is my purpose, therefore, to revive the term first introduced by Eisen, and to show which of the species hitherto placed under *Lumbricus* and *Allolobophora* must be transferred to the subgenus *Dendrobæna*.

In revising Eisen's genus, however, it will be necessary to extend the characters considerably, since he included therein only one species, and that, till now, a very badly described and little understood worm. His diagnosis * is as follows:—

DENDROBÆNA, n. gen.

Tubercula ventralia in segmento 14 [=15 Eng. method].
Setæ ubique æquo intervallo distantes, exceptis duabus summis, quarum intervallum aliquanto majus est.
Lobus cephalicus tres partes segmenti buccalis occupans.

Referring to this subject, Dr. Benham says †:—"Eisen was the first to subdivide the genus *Lumbricus* into subgenera, according to the relative amount of dovetailing of the prostomium into the peristomium. This is accompanied by certain other characters, which have been held sufficient to characterize genera in other cases. So that I have retained his subdivisions *Lumbricus* and *Allolobophora*; but as his genus *Dendrobæna* is only distinguished from the latter genus in having all the setæ equidistant, and as all stages occurring in the separation are found in *Allolobophora*, I agree with Rosa that, we ought not to recognize it."

Consequently the name has been dropped, and in Beddard's 'Classification and Distribution of Earthworms,' 1891, is omitted from notice altogether. The statement of Benham to the effect that every degree of separation of the setæ is found in *Allolobophora* is true till we remove the species which properly fall under the genus *Dendrobæna*, and it is strange that neither Eisen,

* "Om Skand. Lumbr.," in Œfver. af K. Veten.-Akad. Förh. 1873, no. 8, p. 53.

† "An Attempt to Classify Earthworms," in Quart. Journal of Micr. Sci. vol. xxxi. pt. ii. (1890) p. 263.

Rosa, nor Benham has seen the force of this character. Almost without exception do we find that the species of *Allolobophora*, as classified by Eisen, which have the setæ widely separated, are dendrobænic in character. It is true that I shall have to deal with one exception, but this is due to the fact that we are not yet acquainted with all the species which exist, and cannot therefore assign those with which we are familiar their exact position.

I show further on* that in the genus *Lumbricus* we have always a perfect mortise and tenon arrangement of the anterior segments, a girdle composed of six segments, four of which bear the *tubercula pubertatis*, while the colour is purple-brown with iridescence, and the worms secrete no pigmented substance from the dorsal pores. The genus *Allolobophora*, as at present understood, includes worms of very varied characters, and I find that our British species fall readily into groups, of which I propose to name three as follows:—

§ 1. Lumbricoidea. Type *Allolobophora longa*, Ude.
§ 2. Mucida. Type *Allolobophora mucosa*, Eisen.
§ 3. Dendrobæna. Type *Allolobophora celtica*, Rosa.

There are two or three species which do not fit into either of these groups, but their classification has been temporarily set forth by Dr. Rosa. Now I do not intend at present to touch upon the first two groups. They have certain well-marked characters which will justify, in time, their erection into new subgenera†. For the present we will deal only with section 3. In so doing I shall be compelled to bring one of the species out of the genus *Lumbricus*, and two or three from Eisen's genus *Allolobophora*. The characters of the group will be better understood when the different species have been discussed. Generally speaking, however, we may say that the worms are rose-red or flesh-coloured, small, with setæ more or less widely separated, arboreal in character, or found usually in and about decaying timber or tree refuse.

I have named *Allolobophora celtica*, Rosa, as the type. Rosa's original description‡ was based upon three living specimens

* "On a Species of *Lumbricus* new to Science," *infra*, p. 306.

† See Rosa's 'Lumbrici del Piemonte,' where some of these points are more fully treated.

‡ 'Bolletino dei Musei di Zool. ed Anat. Comp. Torino,' vol. i. no. 2, April 1886.

received from Brest, in Brittany, during the month of March 1886. It may be here remarked that in England March is an excellent month for collecting earthworms, as the sexual organs are then becoming active and fully developed. Rosa states that the worms are about equal in dimensions to *Lumbricus purpureus*, Eisen; being from 2 to $2\frac{1}{2}$ millim. in diameter, and 35 to 40 in length. The form is cylindrical, with the posterior part somewhat attenuated. Colour violaceo-pallid dorsally, carneo-livid ventrally. Segments about 100 in number. Cephalic lobe or prostomium with a large backward prolongation which cuts or dovetails into the peristomium to about one half its longitudinal diameter, the lobe being destitute of an inferior longitudinal groove. The male pore situated on segment 15, and extending from the second to the third setæ, the two adjoining segments (14 and 16) being affected. Rosa terms these papillæ carrying the male pore the atria, but Beddard disputes the strict accuracy of this designation *. I prefer for the present to state, when these glandular processes occur, that the male pore is carried by or borne on papillæ. The female pore is well seen, says Rosa, as a small fissure on each side of segment 14 against the second setæ, but on the side external to that occupied by the male pore. The girdle occupies six segments, extending over 31–36, slightly raised and not very closely fused. The *tubercula pubertatis* occur ventrally on segments 33, 34, in the form of a continuous ridge (not on papillæ as in *Allolobophora chlorotica*, for example). Setæ distant, the lateral interval increasing from below upwards, that is, the interval between 2–3 is greater than between 1–2, and less than that between 3–4; the ventral inferior (1–1) not greater than the lateral inferior (1–2); the dorsal interval (4–4) being about twice that of the lateral superior (3–4). The setæ on the ventral surface of segments 31, 32, 35 (before and behind the *tubercula pubertatis*) borne on relieved papillæ. An interesting note on the nephridiopores, which need not be reproduced in this connection, brings Rosa's account to a close.

In 1890 I found three specimens of this worm a few miles north of Langholm, N.B., and the same year three others were discovered in an immature condition near Carlisle, when they were at first mistaken for the young of *Lumbricus purpureus*, Eisen. More recently I have received specimens from, or col-

* "The Classification and Distribution of Earthworms," in 'Proceedings of the Royal Physical Society of Edinburgh,' vol. x. p. 264.

lected them myself in, Devonshire, Gloucestershire, Yorkshire, Northants, Lancashire, Lanark, Sussex, and elsewhere. It is therefore evident that the species is widely distributed in Britain.

It only needs that this species should be studied by the side of *Allolobophora Boeckii*, the type upon which Eisen founded the subgenus *Dendrobæna*, to show that they are very closely allied. I will not at this point inquire what relationship exists between *A. Boeckii* and *Lumbricus puter*, Hoffmeister. Eisen says the girdle is usually composed of five segments (29–33), over three of which (31–33) the *tubercula pubertatis* extend. I give the figures according to the English notation, which makes the peristomium the first segment, and places the male pore on the 15th. Eisen's description published in 1870 is faulty owing to the inclusion of two or three species under one name. The generic title adopted in 1873 was based upon the fact that the worm was found under the bark of decaying trees. It has often been confused with another closely allied species which Eisen first differentiated under the title of *Allolobophora subrubicunda*. This worm is very widely distributed, and when once seen is not easily mistaken for any other, notwithstanding the fact that its girdle or clitellum occupies almost exactly the same position as that of one or two other species. It is true that the Gilt-tail (*Allolobophora subrubicunda*, Eisen) is by no means confined to woodlands, but its affinities are entirely with the Dendrobænas, and it specially delights to live among fallen and decaying leaves, dead branches of trees, and similar vegetable debris. I have found it depositing its egg-capsules quite under the bark of decaying trees.

When Eisen established the genus *Dendrobæna* it is remarkable that he did not place therein his new species *Allolobophora arborea*. It is described as an arboreal or dendrobænic species, and its characters were in many respects so similar to those of his type of the new genus that at first we are astonished to find the two placed under different genera. The fault lay in the fact that Eisen placed too much stress upon one character, to the exclusion of the rest. With him, any worm whose prostomium cut the peristomium in two was a *Lumbricus*, whatever other characters it possessed. In *Dendrobæna* the prostomium occupied about three parts of the peristomium, while in *Allolobophora* the prostomium only slightly cut into or divided the buccal segment. It is now found that this is far too arbitrary and unnatural an

arrangement, and that while undoubtedly every true *Lumbricus* has the peristomium completely divided by the hinder process of the prostomium, yet not every worm with this feature is a true *Lumbricus*. Want of attention to this fact has led to further confusion in the case of a recently discovered worm which Levinsen has described as *Lumbricus Eiseni*. This worm, which was first described from specimens found at Copenhagen, has been obtained by Rosa in Italy, and by myself in various parts of Great Britain; and is a true *Dendrobæna*, notwithstanding the fact that it has the buccal arrangements of a typical *Lumbricus*. In colour and in the disposition of the setæ it somewhat closely resembles *Lumbricus purpureus*, Eisen, but there the resemblances end. The true *Lumbricus* has always six girdle segments, in this worm there are eight or nine. In *Lumbricus* the *tubercula pubertatis* stretch across the four inner segments of the girdle, here they are absent, or if present their position is abnormal. In *Lumbricus* there are two pairs of spermathecæ, in this worm they are entirely wanting. *Lumbricus* emits no yellow fluid; this species does, though not always. *Lumbricus* is a true earthworm, this is as truly dendrobænic. Surely these are characters which cannot be ignored, and show conclusively that the mere shape of the prostomium is an insufficient generic character unless accompanied by others which are permanent.

We are now in a position to consider the several British species of the subgenus *Dendrobæna* which have so far been observed and described.

Genus Allolobophora, § Dendrobæna = Group No. 3 of Rosa's Classification.

1. A. (Dendrobæna) celtica, *Rosa*. (Pl. XXI. figs. 8, 9.)

Prostomium only partially dovetailed into the peristomium. Individual setæ somewhat widely separated. Length 1 to 1½ inches, of a dark brown or violaceous colour dorsally, tending to iridescence; lighter on the ventral side. Clitellum flesh-coloured, dirty yellow, or grey, and depending considerably on the habitat, occupying 6 segments (31–36); *tubercula pubertatis* on 33–34. Male pore on segment 15, borne on papillæ which extend to segments 14 and 16. In adult specimens segments 9, 25, and 26 also have glandular tumidities or papillæ. First dorsal pore between 5 and 6. Copulatory setæ on segments 31, 32, 35. About 100 segments.

Synonym: *Allolobophora celtica*, Rosa, Boll. Mus. Zool. Torino, 1886.

Found under bark of decaying trees, among dead leaves, or under vegetable mould. Scotland:—Dumfriesshire (Langholm, 1890); Lanarkshire (Paisley, 1892). England:—Devonshire (Bovey Tracey, 1890); Gloucestershire (Painswick, Mr. Watkins, 1891); Yorkshire (Idle, 1891); Kent (Tunbridge Wells, 1892); Northants (Brackley, Mr. Blaby, 1892); Sussex (Dallington, 1892); Lancashire (Morecambe, 1892). Continental records:—Brittany (Brest, Dr. Rosa, 1886); Italy (Rosa, 1887).

2. A. (Dendrobæna) Boeckii, *Eisen*. (Pl. XXI. fig. 2.)

This worm has rarely been taken in England. I have, in fact, up till the present only three absolutely reliable records. The species is well-defined, but there has been in the past endless confusion owing to the supposed connection between it and *Lumbricus puter*, Hoffmeister. Eisen's description is very brief, and I therefore describe the species from my own material.

Prostomium more deeply imbedded in the peristomium than in the last species. Male pore on segment 15, on somewhat prominent papillæ. First dorsal pore large, between segments 5 and 6. Girdle of 5 segments normally, covering 29–33, with *tubercula pubertatis* on (30), 31, 32, 33 (Rosa and Eisen give 31, 32, 33, but one of my specimens was as described). Anal segment somewhat pear-shaped. Length about $1\frac{1}{2}$ inches (Rosa gives 25–35 millim. for specimens in spirits). Total number of segments 80–100. Colour reddish brown, with red clitellum and light, flesh-coloured ventral surface. Setæ in 8 almost equidistant rows. Although Eisen and many others have regarded *Lumbricus puter*, Hoffm., as corresponding with this species, my examination of the subject negatives the idea *, and I have no hesitation in referring Hoffmeister's worm to Eisen's *Allolobophora subrubicunda*—a worm which is far more widely distributed than *D. Boeckii*, and one which has been mistaken for the latter by many authors. I regard this species as being without synonyms, and take Eisen's description as the original account of a new species as well as a new genus. This worm is so much like *Lumbricus purpureus*, Eisen, that it might easily pass as a true *Lumbricus*. We may compare also *L. melibæus*, Rosa.

* I am glad to find myself supported in this view by so reliable an authority as Dr. Rosa, of Turin.

Found in similar haunts to those chosen by the last species. England :—Yorkshire (between Bolton Abbey and The Strid, July 1891; Apperley, 1892). Scotland (Paisley, 1892). Continental records :—Norway, Prof. Boeck (after whom the species is named: *cf.* Eisen in Œfver. af K. Vet.-Akad. 1873, no. 8, pp. 53-54). Italy (Rosa, Lumb. del Piemonte, p. 48).

3. A. (Dendrobæna) subrubicunda, *Eisen.* (Pl. XXI. fig. 4.)

A well-defined species, and more widely distributed than any of the other dendrobænic forms. It often occurs by scores and hundreds in the midst of vegetable debris on the banks of Yorkshire and other streams, and is easily recognized. It is the largest and in point of size the most variable species of the group, and is more frequently found away from trees than the others.

Eisen described it in 1873 as a new species, but I am convinced that this is the *Lumbricus puter* of Hoffmeister, and must be identical with many of the worms which are now reckoned as synonymous with this. Eisen's description is clear and full, so far as external characters are concerned, and a slightly modified translation, to meet our methods of notation, will exactly suit our indigenous species.

Body cylindrical, somewhat depressed anteriorly and attenuated posteriorly, flattened on the under surface. Prostomium large and pallid, dividing the peristomium to about one half its diameter. Girdle large and conspicuous, of a dull grey colour, and usually covering six or seven segments, 25, 26–31. On each side of the girdle ventrally, and covering segments 28, 29, 30, is a band which constitutes the *tubercula pubertatis.* Setæ in distant couples, not close together as in *Lumbricus*, or slightly separated as in the Brandling. Total number of segments about 90 or 100, length averaging 90 millim.

I may add that the colour is rosy red, with somewhat lighter under surface. Setæ on pale glands, which arrangement makes them conspicuous. Spermathecæ opening in the line of the dorsal setæ (*Rosa*).

A tender delicate worm, well adapted for bait. It is largely employed by anglers in England, under the name of the Cockspur or Gilt-tail; the latter name being derived from the colour of the anal extremity. When a drop of methylated spirit is placed upon the living worm it exudes a yellow fluid, and this may be readily observed flowing from the dorsal pores, the first of which

occurs, as Ude has correctly pointed out, between segments 5 and 6. Spermathecæ are found in the 10th segment, which open in intersegment 9/10 in the direction of the superior pair of setæ.

Eisen gives full directions for distinguishing between this species and the Brandling (*Allolobophora fœtida*, Sav.); but if examined in a living condition, these instructions are absolutely unnecessary. Benham is in error* when he says *A. subrubicunda* is destitute of spermathecæ and *tubercula pubertatis*.

Synonyms: *Allolobophora subrubicunda*, Eisen (*op. cit.* p. 51). *Lumbricus puter*, Hoffmeister, 1845; *Dendrobæna puter* (Œrley, 'A Mag. Olig. Faunája,' 1880, p. 586). Œrley has rightly identified the worm, but did not recognize that it was the same as Eisen's *subrubicunda*. He, however, doubted the accuracy of assigning *L. puter*, Hoffm., to *D. Boeckii*, Eisen. To this species, and not to *D. Boeckii*, Eisen, as Rosa suggests, we must, I think, relegate the *Enterion octaedrum*, Savigny, and perhaps also *A. Fraissei*, Œrley.

Widely distributed both in England and abroad. Among British localities I may mention Yorkshire, Gloucestershire, Devonshire, Northants, Hertfordshire, Middlesex, Essex, Kent, and Sussex. It is recorded also for Siberia, Russia, Sweden, Italy, Hungary, &c.

4. A. (Dendrobæna) constricta, *Rosa*.

During a visit to the south of England in the spring of this year I had the good fortune to find a new British species of dendrobænic worm, which, for want of a popular name, I designate the Narrow-ring Worm (*A. constricta*, Rosa). As it corresponds entirely with Rosa's description, which has never been printed in English, I give a translation of the original†. The medium length of this species is about 25 millim.; while it may extend to 45 when living, in alcohol it is usually nearer 20 millim. The number of segments, which are closely compressed, is about 90 to 100. The form is cylindrical, with a gradual attenuation of the two extremities. The girdle is swollen, and when the animal is contracted assumes a globose shape. The colour is fundamentally a transparent flesh- or rose-red. The intestine may be seen in the parts which are less pigmented—the colouring-matter being (as frequently in the Gilt-tail, which

* 'Attempt to Classify Earthworms,' Q. J. M. S. xxxi. p. 260.

† 'Il Lumbrici del Piemonte,' 1884, pp. 38–9.

it very closely resembles) disposed in bundles alternating with the intersegmental groove. The prostomium dovetails into the first segment to about two thirds of its diameter. The male pores are easily seen on the white papillæ of the 15th segment. The girdle is constant upon segments 26 to 31, but there are no bands (*tubercula pubertatis*). The setæ are disposed in wide pairs or nearly equidistant rows. The worm is very active, as indeed are most of the group, and like the others it emits a yellow inodorous fluid. It is distinguished from the Gilt-tail by the greater number of segments compressed into the same length, and the absence of the band. There are no synonyms, and its known distribution is Italy (Ceres and Rosazza) and England (Dallington, Sussex).

5. A. (Dendrobæna) arborea, *Eisen.* (Pl. XXI. fig. 3.)

This diminutive worm was first described by Eisen in 1873. It appears to have been as entirely overlooked up till that date as the last-named species was till eight years ago; and I have little doubt but that in future years, when the decaying forest trees of other lands come to be explored, we shall find several other species which up till the present time have passed altogether unobserved. The description of Eisen is true of our native species. Body cylindrical, prostomium large and pale, occupying about one half of the first segment. Male pores on segment 15 tumid and conspicuous. Girdle for the most part composed of six segments extending over 26–31. *Tubercula pubertatis* on the 14th and 15th segments behind the male pore, *i. e.* on segments 29, 30. The anal segment somewhat exceeds that which precedes it in length. The setæ are everywhere in distant pairs. Segments 50–60 (sometimes more in British specimens); length about 50 millim. (not so great in my British specimens). First dorsal pore between 5 and 6. Like *Dendrobæna Boeckii* (says Eisen), this species is found in old stumps of trees, into which, however, it penetrates further than the latter species. The specimens sent me from Gloucestershire were found deep in the wood, while two other species (*A. celtica* and *A. Eiseni*) were found in the same stump less deeply imbedded. Eisen examined one specimen in which the *tubercula pubertatis* extended over segments 28–31. At first sight the species resembles *D. Boeckii*, remarks Eisen, and it is marvellous that he should found a genus for tree-haunting worms, and exclude from it his own *arborea*.

Synonym: *Allolobophora arborea*, Eisen (Om Skand. Lumb. 1873).

English records:—Gloucester (Painswick, Mr. Watkins, 1892); Sussex (Dallington, 1892); Yorkshire (Esholt, 1891); Norfolk (Norwich, Mr. A. Mayfield, 1892). On the Continent Eisen records its occurrence in "Skåne, Vestergötland och Valders i Norge." He refers to it as the rarest of Swedish worms. I cannot find any record up till the present date for Germany, Italy, or Hungary. Dr. Rosa seems not to have met with it.

6. A. (Dendrobæna) Eiseni, *Levinsen*. (Pl. XXI. figs. 7, 10.)

Hitherto this worm has happily passed through the hands of systematists invariably as *Lumbricus Eiseni*, Levinsen; but the time has come when it must be removed from the false position it has occupied undisturbed till the present. It must, however, be admitted that it does not fit in with the genus *Allolobophora*, though it belongs to this place as a true tree-worm.

The worm is small, cylindrical, slightly attenuated, usually about an inch, or at most an inch and a half, in length, *i. e.* 30 to 40 millim. Its prostomium, like that of the true *Lumbricus*, forms with the peristomium a perfect mortise and tenon. It often closely resembles the typical *Lumbricus* in colour, being a warm brown, frequently with iridescence, and has the setæ in couples somewhat close together. These are its only affinities in that direction. It lives in old trunks of trees and among decaying timber or woodland debris, is small, destitute of the two pairs of spermathecæ which every true *Lumbricus* possesses, and in the matter of *clitellum* and its accessories is separated very widely from that genus.

The girdle covers eight segments, extending from 24 to 31; total number of segments 90–110. There are no *tubercula pubertatis*; the male pore on segment 15 is on papillæ slightly developed, and the first dorsal pore is between 5 and 6. The constancy of this feature in the dendrobænic group is striking. Rosa submitted specimens exactly answering this description to Levinsen, who stated that they were identical with his *Lumbricus Eiseni**. The original specimens from Copenhagen were taken, according to Rosa's translation of Levinsen's account, from old trees, and my English specimens have been obtained from similar habitats.

* Bolletino Mus. Zool. ed. Anat. 1887, 1889.

Synonym: *Lumbricus Eiseni*, Levinsen (Syst. geogr. Oversigt over de nord. ann. &c., Copenhagen, 1883).

Found in the following localities in England:—Cumberland (Carlisle, 1890); Gloucestershire (Painswick, Mr. Watkins, 1892, *see* 'Nature,' February 18th, 1892); Sussex (Dallington, March 1892); Epping Forest. The Continental records are Copenhagen, Azores ?, Piedmont, and Rivarossa.

We are now prepared for a survey of the principal characteristics of the group.

§ Dendrobæna, *Eisen*.

Small tender worms, from 1 to $2\frac{1}{2}$ inches in length, found in decaying trees, among dead leaves, and rotten vegetable matter; sometimes wandering to other habitats. Colour usually brown, rose-red, or flesh, with dull clitellum and lighter under surface. Prostomium more or less deeply imbedded in the peristomium, which is without setæ. Setæ always in eight rows or in four couples, more or less distant, making the body appear rectangular.

Girdle occupying five to eight segments, commencing somewhere between the 24th and 31st.

Male or spermiducal pores on segment 15, usually with prominent papillæ, which sometimes extend over the two adjoining segments.

Tubercula pubertatis in two or three pairs on consecutive segments; not observed in one species.

First dorsal pore usually between segments 5 and 6. Spermatophores between the male pore and the clitellum.

The internal characters have not yet been made out with sufficient accuracy by any investigator to allow of classification. Spermathecæ are present in some species, but absent from others. When present they open in the direction of the superior pair of setæ (*Rosa*).

Usually secreting a small quantity of yellow fluid from the dorsal pores.

The accompanying table (p. 304) supplies in concise form the principal distinguishing features of this interesting group of worms.

Tabular View of British Allolobophoræ.

§ Dendrobæna.

Name.	Clitellum occupies	Tubercula pubertatis.	First Dorsal Pore.	Total segments.	Length.	Colour.	Prostomium imbedded.	Setæ.
1. *celtica*, Rosa	31–36	33, 34	5/6 ?	90–110	1–1½ in.	Brown or Rose-red.	Partially.	4 pairs wide.
2. *Boeckii*, Eisen	29–33	31, 32, 33	5/6	90–100	1–1½ in.	Red-brown.	Two thirds.	8 rows.
3. *subrubicunda*, Eisen ...	25–31	28, 29, 30	5/6	100–120	1½–2½ in.	Rose-red.	Partially.	4 pairs separated.
4. *constricta*, Rosa	26–31	0	5/6	90–100	1 in.	Rose-red.	Two thirds.	4 pairs separated.
5. *arborea*, Eisen	26–31	29, 30	5/6	50–80	1 in.	Rose-red.	Slightly.	4 pairs wide.
6. *Eiseni*, Levinsen	24–31	0	5/6	90–110	1½ in.	Red-brown iridescent.	Completely.	4 pairs close.

II. On a new Species of Lumbricus.

During the summer of 1890 I collected a large series of Earthworms, with the intention of drawing up a complete catalogue of all the species to be found in Yorkshire, where I was residing. The material thus obtained was passed under rapid review, and then put aside till I should be able to command sufficient leisure for a more detailed examination.

Among the specimens taken in the immediate neighbourhood of my residence I observed some worms which I was unable to correlate with any one of the species known as British, and as I extended my investigations it became more and more apparent that I had alighted on a species which was not only new to Britain, but one which was also unknown to science.

Having recently had occasion to devote some time to the more thorough and exhaustive examination of our worm-fauna, and having at the same time discovered my new species in several parts of the country, I purpose in this paper, not only submitting a detailed account of the worm in question, but showing how we stand at present in relation to the genus as a whole. For some years past I have been working persistently at the family Lumbricidæ, to which all our indigenous earthworms belong, and now feel that I am in a position to deal with the different genera in a fuller manner than has been possible with any previous writer on British earthworms.

It seems desirable in the first place to give a diagnosis of the external characters of the species, to which, for reasons to be assigned hereafter, I have given the name *rubescens*. Internally, so far as my examination has proceeded, there is no new or abnormal feature to record, the worm answering in all respects to the typical *Lumbricus*. In the matter of terminology I shall follow Eisen, who was the first to distinguish *Lumbricus* from *Allolobophora*.

Lumbricus rubescens, sp. nov.

Corpus elongatum aut crassum, antice cylindricum, attenuatum, postice depressum.

Lobus cephalicus (sive prostomium) magnus, antice rotundatus, supra in medio sulco transverso præditus; postice segmentum buccale (id est peristomium) in duas partes dividens; infra pallidus, sulco longitudinali furcato.

Tubercula ventralia plerumque conspicua in segmento 15.

Cingulum prominens, e sex segmentis (34–39) semper confectum; infra duobus parallelis tuberculis, in segm. 35, 36, 37, 38.

Setæ binæ approximatæ.

Segmenta circa 100–120.

Longitudo circa 10 cm.

Prima foramen dorsi inter segmenta 5–6.

Like the other true species of *Lumbricus*, this worm is anteriorly of a purplish-brown colour, iridescent, especially on the dorsal surface, and lighter along the hinder quarter as well as ventrally. The colour of the girdle or clitellum is a warm brown, corresponding closely to that of the posterior extremity, but somewhat darker than the ventral surface of the worm's body. The prostomium or cephalic lobe forms a perfect "mortise and tenon" with the first or buccal segment, which is, as usual, without setæ.

The term "mortise and tenon" is a much more accurate one than "dovetail," which Benham employs. The latter is the more appropriate term, however, for the species of *Allolobophora*. It may be here pointed out that every known species of *Lumbricus* is distinguished from all other species of British worms by the presence of an iridescent purple-brown colour, inseparable from the "mortise and tenon" arrangement of the anterior extremity, and coupled with a girdle of six segments, *tubercula pubertatis* forming a band across the inner four, setæ in four closely approximated couples, and the ability to secrete a slimy mucus, but not a turbid liquid. Internally there are two pairs of spermathecæ and three pairs of sperm-sacs. As I have already pointed out*, the so-called *Lumbricus Eiseni*, Levinsen, is not a true *Lumbricus*, although it resembles that genus of worms in one or two particulars.

In shape and size this species is exactly intermediate between the common earthworm (*L. terrestris*, L.), as defined hereafter, and the red worm (*L. rubellus*, Hoffm.). It may in fact be readily confounded with the latter at first sight, just as the red and purple worms were, till Eisen pointed out their distinctive characters. The setæ are always in couples, the individuals of which are nearly close together, while each couple is separated by a moderate interval from the next, as in each of the other species.

* "On the Tree-worms of Great Britain," *supra*, p. 302.

The male pores, known to Eisen as *tubercula ventralia*, and termed spermiducal pores by Benham, are situated on segment 15, and are borne upon prominent papillæ. In this respect the worm corresponds with our common earthworm (*L. terrestris*, L.) and with the Continental *L. melibœus*, Rosa, but differs from our other native species. Rosa terms these papillæ atria; but Beddard, as I have stated already, demurs somewhat to the use of the designation. In the purple worm (*L. purpureus*, Eisen) and the red worm (*L. rubellus*, Hoffm.) the papillæ are totally wanting, and the 15th segment is destitute of every feature indicating its importance in the sexual relationship. As a consequence the pores cannot be distinguished as a rule, even with a lens. As we find a pair of tumid projections on the adult earthworm (*L. terrestris*) under segment 26, so in this species we have a pair of papillæ on the ventral surface of the 28th and 29th (or 29th and 30th) segments. This posterior position corresponds with that of the clitellum, which commences on segment 32 in the common earthworm, but on 34 in the new species.

Although it is much easier to determine the species of a worm when adult than when immature, just as an umbelliferous plant can be more readily determined when in fruit than when bursting into flower, yet in the present instance there is an advantage in the case of the immature specimens over those of other species, on account of the very prominent copulatory setæ found on segments 10, 12, 29, 33–40. The clitellum extends from the 34th to the 39th segments, but the two adjoining somites usually bear copulatory setæ as well, a fact which seems to indicate that the girdle formerly occupied eight instead of six segments. This point is of value when we remember that in *Allolobophora* the clitellum is frequently found to cover eight segments, which is also the normal number in *L. Eiseni*, Lev. The *tubercula pubertatis* form a distinct band on either side of segments 35–38, and this striking case of uniformity in each of our British species affords one good reason for excluding from the genus such aberrant forms as *Lumbricus Eiseni*, Levinsen, and some others which have been classed as *Lumbrici*. In every genuine *Lumbricus* the girdle occupies six segments, while the *tubercula pubertatis* form a band along the four middle segments. I have examined thousands of specimens, and in every normally developed adult have found this rule to hold good. I cannot insist too strongly on this point as an important key to classification. If a worm is found with

seven or eight girdle-segments, and the *tubercula pubertatis* occupy alternate segments, or are found as pores on two or three segments on the posterior portion of the girdle, it cannot be a true *Lumbricus*. On the other hand, an *Allolobophora* may have six girdle segments and four *tubercula pubertatis*, as, *e. g.*, in *A. profuga*, Rosa.

The segments in this species are not as a rule strongly annulated, or divided into rings; but even in the closely-related species, which are said by some authors to be always bi- or triannulate, I have found great diversity. The first dorsal pore is situated between segments 5 and 6. Notwithstanding Ude's careful researches, I am a little in doubt about the constancy of the first dorsal pore, and am of opinion that its position varies with the age of the worm, at least in some species. I have discovered that these pores are not only valuable on account of their close connection with the dorsal vessel, to which they afford the necessary oxygenation, but also on account of their connection with the glands employed in secreting mucus and protective fluids *. If one of the worms which exude a yellow fluid containing a considerable proportion of solid matter is held in such a position that its pores can be seen while a drop of spirit is placed on its body the coloured matter will at once be seen to stream forth from the pores in a very striking manner, and, as a rule, the first pore can instantly be detected by this means.

Internally *L. rubescens* has the normal number and arrangement of the various organs. There are two pairs of spermathecæ in segments 9 and 10, the gizzard occupies the 17th and 18th segments, and the œsophageal or calciferous glands are in segments 11 and 12. There are three pairs of sperm-sacs, or *vesiculæ seminales*, in segments 9, 11, and 12, and the usual arrangement of pharynx, nephridia, and other organs.

I have adopted the specific name of this worm first of all because it is as near the truth respecting the colour of the animal as either *rubellus* or *purpureus*. In fact, the whole of this group of worms so exactly resemble each other in this respect that any name drawn from, or applied to, their coloration must be vague at best. This name, however, commends itself to me on the ground that it has already been assigned to a British earthworm which was never properly described. I have therefore

* Rosa especially has called attention to this and other important points.

assumed the identity of the two worms and utilized the nomenclature in order to avoid adding another to the bewildering list of names already in use.

Templeton, years ago, found a worm "common in rich grounds, generally where docks grow," which he describes in the following terms :—"Body long, contractile, cylindrical, with a compressed lanceolate apex [posterior], unfurnished with a belt at the position of the sexual organs. Each ring with very small spines projecting backwards."

When I first discovered the species I have been describing the girdle was still undeveloped, though the region it was to occupy was well defined and slightly lighter in colour. It corresponded so exactly with Templeton's further account that I concluded he must have seen the same worm. He adds :—"It is never larger than half the size of *L. terrestris*; and is of a bright reddish-brown, with the hinder part, or apex, very flat."

The characters will be summarized when we come to survey the genus with a view to the better understanding of the various species found in Great Britain.

Lumbricus rubescens was first discovered between Idle and Eccleshill, near Bradford, Yorks, in 1890. During the present year (1892) I have taken it freely at Dallington, in Sussex (March 28th), while I obtained one specimen near a little gutter on the Common at Tunbridge Wells, Kent (March 26th), and another at Hornsey, in Middlesex (March 31st). I have also received specimens from Avonmouth, Norwich, and Paisley. The Dallington specimens were obtained by shaking the ground in a sheltered meadow with a gardening fork, when they came out in fine condition. On one of these specimens I found a pair of spermatophores attached to the ventral surface of segment 32, and differing in shape and appearance from those so accurately figured by Vejdovsky as found on the Green Worm (*Allolobophora chlorotica*). The total number of segments is about 120, the worm being usually from 3 to 4 inches in length. It is exceedingly active, and is usually found along with the Red Worm (*L. rubellus*, Hoffm.), with which it may be easily confounded, and with which I have also found it in copulation.

Synonyms.—Assuming the identity of this species with the one referred to above, the synonyms are *Lumbricus omilurus* = *Omilurus rubescens*, Templeton, Loudon's Mag. Nat. Hist. ix. p. 235 (*fide* Johnston, 'A Catalogue of British Worms,' 1865, p. 63).

Dr. Rosa has called my attention to the fact that a worm was imperfectly described some years ago under the name of *L. festivus*, Savigny, in which the girdle segments occupy the same position as that indicated for *L. rubescens*, Friend. The other characters, however, are too little known to justify the inclusion of the name here.

As by the discovery of this worm a slight alteration in the generic characters of *Lumbricus* is made necessary, I shall here, in the first place, emend the recently-published analysis of Benham *, and then describe the different species at present known to occur indigenously in Great Britain. A list of synonyms may then very properly be appended. The revision relates only to our native species, but will apply to those found abroad as well.

A Revision of the Genus Lumbricus, *Linn.*

Prostomium forming with the peristomium a perfect "mortise and tenon."

Setæ 8 in each segment, always in couples, the individuals of which are in close proximity. Those on the clitellum, and on certain other segments, differing by their greater length, never ornamented.

Clitellum always composed of six segments, commencing somewhere between segments 26 and 34.

Male or spermiducal pores on segment 15, either with or without papillæ.

Sperm-sacs, or vesiculæ seminales, three pairs in segments 9, 11, 12, connected across the middle line by sacs enclosing the testes and ciliated rosettes. Testes in segments 10, 11, ovaries in segment 13.

Spermathecæ in segments 9 and 10, two pairs opening posteriorly.

Gizzard in segments 17–18.

Calciferous or œsophageal glands in segments 11, 12.

Nephridia simple, meganephric, in pairs in each segment except the most anterior.

Tubercula pubertatis, four on each side, forming a band along, or near to, the ventral limit of the clitellum, omitting the first and last segments.

* "An Attempt to classify Earthworms," in Q. J. M. S. vol. xxxi. 1890, pt. ii. pp. 258–9.

Colour purplish or ruddy brown with iridescence, paler ventrally, and with the clitellum lighter than the anterior portion.

Form cylindrical, more or less flattened posteriorly.

First dorsal pore may begin between segments 5 and 6 or posteriorly to this.

Nephridiopore in a line with the inner couple of setæ.

Anus terminal.

Spermatophores, in the breeding-season, attached to the body between the male pores and the hinder extremity of the clitellum.

Body often covered with mucus, never exuding a coloured, granulated fluid.

British Species of Lumbricus.

1. Lumbricus terrestris, *Linn.*

The largest indigenous species. Regarded as very common, but in most cases confounded with one or other of the Lumbricoid Allolobophoras, especially *Allolobophora longa*, Ude, which is much more common and widely distributed.

The internal structure is normal. It is usually 4 to 6 inches or more in length; of a warm brown colour, iridescent. The male pores are easily seen, owing to pale-coloured papillæ on segment 15. The girdle always extends from the 32nd to the 37th segment in the typical species. This point must be emphasized to avoid further confusion. *Tubercula pubertatis* forming a band on segments 33, 34, 35, 36. Tail flattened; setæ in four double rows. First dorsal pore between segments 8/9 (*Ude*). Copulatory setæ on papillæ on segment 26.

Synonyms numerous. The distribution has been only partially worked out, owing to confusion in former identifications. I retain the name given to the earthworm by Linnæus because the other worms which were confounded with it have now all been removed to the genus *Allolobophora*, so that there is no need to alter the original designation.

The subject of the possible hybridization of this species with other species of *Lumbricus* or *Allolobophora* has hitherto received too little attention *. Some so-called varieties are now known to be true species, and will be found among the separated genus.

2. Lumbricus rubescens, *Friend.* (Pl. XXI. fig. 12.)

Next in size to the foregoing, and intermediate between it and the following. Similar in colour, shape, and the arrangement of

* See an article on this subject in 'Field Club,' 1892.

the parts. Male pores on prominent papillæ on segment 15. Readily identified by the backward position of the girdle, which covers segments 34 to 39. *Tubercula pubertatis* on 35, 36, 37, 38, forming a band along the clitellum omitting the first and last segments. First dorsal pore between segments 5 and 6, thus filling up a gap in the series as shown in the following table. Copulatory setæ on segments 29, 30, as well as on the under surface of the clitellum. Spermatophores transparent sacs attached to the ventral surface in front of the clitellum.

Distribution, so far as at present known, Scotland to Gloucestershire and Sussex; at present peculiar to Great Britain, unless *L. festivus*, Savigny, should prove to be the same. This worm has, however, been observed by no recent investigator on the Continent.

3. Lumbricus rubellus, *Hoffmeister*.

Somewhat smaller than the foregoing. Usually about 3 inches in length, purple, with brick-red clitellum, which is very prominent in the adult worm, and extends from the 27th to the 32nd segments. Eisen has rightly pointed out that occasionally the girdle is shifted bodily one segment forward (26 to 31), but this is of rare occurrence in Great Britain. The male pores cannot be detected on segment 15, even with a lens, but when the worm is adult a band connects it with the girdle. The first dorsal pore is between segments 7 and 8.

It is widely distributed both at home and abroad, and has not received so many aliases as most species have. It was first distinguished as a species by Hoffmeister in 1845. Œrley, owing to his error in the identification of *Lumbricus terrestris*, L., revived Savigny's name *Enterion* for this and the next species. Hoffmeister's designation, however, has undisputed right to be retained.

I have found this species at times with a very limited number of post-clitellian segments, causing the worm to assume a very characteristic appearance (var. *curticaudatus*, Friend); I have, however, failed so far to determine whether the effect is due to soil, height above sea-level, want of proper food, or otherwise.

4. Lumbricus purpureus, *Eisen*. (Pl. XXI. fig. 11.)

The smallest of our true *Lumbrici*, usually measuring about 2 inches in length. It is, however, very variable in size: some-

times approaching the preceding, at other times becoming quite diminutive. The girdle is situated on segments 28 to 33, the *tubercula pubertatis* forming the usual band on segments 29 to 32. The first dorsal pore is between 6 and 7. This, like the last, may often be found in certain localities with a very short tail, so that the girdle appears right in the middle of the body. The male pore may sometimes be distinguished, though there are no papillæ. It breeds freely under clots of dung in pastures, and is a most valuable scavenger. It is as widely distributed as the last.

Though Eisen gave it the name which it now bears in 1870, it was already known to science, having been described in 1829, and known as *Enterion castaneum*, Savigny, or *L. castaneus*, Dugès, on account of its chestnut colour. So far as my researches have gone this species occurs at a greater altitude in Great Britain than either of the other three species. It is usually a good deal larger south of the Thames than north of the Solway.

The Continental *Lumbricus melibœus*, Rosa, has not yet been found in Great Britain; of *Lumbricus caucasicus*, Kulagin, reported to occur in South Russia, I know nothing. *Lumbricus Eiseni*, Levinsen, as I have shown elsewhere, is an aberrant species, and though found in several places in England, is more naturally ranked with the Dendrobænas. These are the only species which at present claim to be genuine European Lumbrici, so that out of the six possible species four are indigenous to this Island, one of which appears so far to be peculiar to Britain.

The following table (p. 314) will give a bird's-eye view of the genus so far as our present knowledge goes.

A Revised Synonymy of British Worms.

Lumbricus	agilis, *Hoffm.*	=	Allurus tetraedrus, *Eisen.*
,,	agricola, *Hoffm.*	=	Lumbricus terrestris, *Linn.*
,,	amphisbæna, *Dugès*	=	Allurus amphisbæna (*Dugès*).
,,	anatomicus, *Grube*	=	Allolobophora turgida, *Eisen.* Allolobophora mucosa, *Eisen.*
,,	anatomicus, *Dugès*	=	Allolobophora riparia, *Hoffm.*
,,	annularis, *Temp.*	=	Allolobophora fœtida, *Eisen.*
,,	calignosus, *Dugès*	=	Allolobophora mucosa, *Eisen.*
,,	carneus, *Hoffm.*	=	
,,	chloroticus, *Grube*	=	Allolobophora riparia, *Hoffm.*
,,	ciliatus, *Müller*	=	Valla ciliata, *Johnston.*
,,	castaneus, *Sav.*	=	Lumbricus purpureus, *Eisen.*
,,	communis, *Hoffm.*	=	Allolobophora mucosa, *Eisen.* Allolobophora turgida, *Eisen.*

A Tabular View of the Genus Lumbricus (*Linn.*).

Lumbricus.	Segments occupied by					Total number of segments.	Average length.	When described.
	Girdle.	Tub. pub.	1st pore.	Male pore.	Papillæ.			
terrestris, L.	32–37	33–36	8/9	15†	26	150–200	5 in.	1757
rubescens, Friend	34–39	35–38	5/6	15†	28	100–130	4 in.	1892
rubellus, Hoffmeister ...	27–32	28–31	7/8	15	0	100–120	3 in.	1845
purpureus, Eisen	28–33	29–32	6/7	15	10	80–100	2 in.	(1829) 1870
melibœus, Rosa	29–33	30–33	7/8	15†	?	110–125	3 in.	1884

† Indicates the presence of papillæ (Rosa's so-called atria).

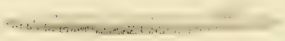
Lumbricus complanatus, *Dugès*	=	Allolobophora complanata, *Dugès.*
,, cyaneus, *Hoffm.*	=	Allolobophora turgida, *Eisen.*
,, Eiseni, *Levinsen*	=	A. (Dendrobæna) Eiseni, *Levinsen.*
,, fœtidus, *Savigny*	=	Allolobophora fœtida, *Savigny.*
,, gordianus, *Temp.*	=	Allolobophora turgida, *Eisen.*
,, herculeus, *Sav.*	=	Lumbricus terrestris, *Linn.*
,, lividus, *Temp.*	=	Allolobophora turgida, *Eisen.*
,, major, *Mouf.*	= }	Lumbricus terrestris, *Linn.*
,, maximus, *Leach*	= }	
,, minor, *Johns.*	=	Lumbricus purpureus, *Eisen.*
,, multispinus, *Grube*	=	Euchytræus albidus, *Henle.*
,, octaedrus, *Sav.*	=	Allolobophora subrubicunda, *Eisen.*
,, olidus, *Hoffm.*	=	Allolobophora fœtida, *Eisen.*
,, omilurus, *Temp.*	=	Lumbricus rubescens, *Friend.*
,, pulchellus, *Leach*	=	Lumbricus purpureus, *Eisen.*
,, puter, *Hoffm.*	=	Allolobophora subrubicunda, *Eisen.*
,, riparius, *Hoffm.*	=	Allolobophora riparia, *Hoffm.*
,, rufescens, *Johnst.*	=	Lumbricus rubescens, *Friend.*
,, terrester, *Grube*	=	Lumbricus terrestris, *Linn.*
,, tetraëdrus, *Dugès*	=	Allurus tetraedrus, *Eisen.*
,, trapezoideus, *Dugès*	=	Allolobophora trapezoidea, *Dugès.*
,, virescens, *Sav.*	= }	Allolobophora riparia, *Hoffm.*
,, viridus, *Johnst.*	= }	
,, xanthurus, *Temp.*	=	Allolobophora subrubicunda, *Eisen.*

EXPLANATION OF PLATE XXI.

Fig. 1. Typical tree-worm.
2. Girdle and band of *Allolobophora* (§ *Dendrobæna*) *Boeckii*, Eisen.
3. Girdle and band of *A.* (§ *Dendrobæna*) *arborea*, Eisen.
4. Girdle and band of *A.* (§ *Dendrobæna*) *subrubicunda*, Eisen.
5. Distribution of setæ (diagram).
6. Head of typical tree-worm.
7. Head of *A.* (§ *Dendrobæna*) *Eiseni*, Levinsen.
8. Male pores and papillæ of *A.* (§ *Dendrobæna*) *celtica*, Rosa.
9. Girdle and band of the same.
10. Girdle of *A.* (§ *Dendrobæna*) *Eiseni*, Levinsen.
11. *Lumbricus purpureus*, Eisen.
12. *Lumbricus rubescens*, Friend.
13. Head of typical *Lumbricus*.

cl., clitellum or girdle ; *m.p.*, male pore ; *per.*, peristomium ; *pr.*, prostomium ; *t.p.*, tubercula pubertatis or band.

The small figures indicate the number of the segment; counting the peristomium as the first. Figs. 1, 11, 12, natural size; all the rest enlarged about 5 diameters. Figs. 2, 3, 4, 9, 10 are lateral views; 6, 7, and 13 are dorsal.



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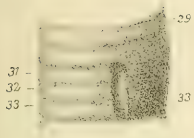

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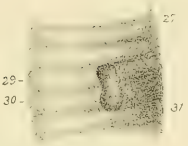

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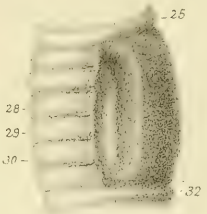

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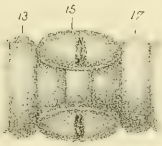

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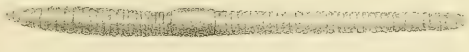

11

12

13

H.Friend del. ad nat. Hanhart lith. A.R.Hammond lith.

BRITISH TREE AND EARTH WORMS.